A "Know-How vs. Know-What" Approach in the Teaching-Learning of Competences in Physical Chemistry

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INTRODUCTION

Knowledge can be acquired from a series of **perspectives**, mainly: **"know-what" (concept)**, where facts and descriptions of (natural or social) phenomena are pursued; **"know-how" (procedure)**, where methods and procedures for their application are described; and **"know-why" (competence)**, where general principles and laws that explain both the facts and their applications are sought. The depth of student's acquired competences will be directly affected by the teaching-learning perspective, traditionally aiming to a "know-why" approach. In this work, we discuss a suitable **teaching-learning methodology** for evaluating whether a **"know-how", a "know-what" or a combined approach** is better for enhancing competence learning.

KNOWLEDGE

Acquisition

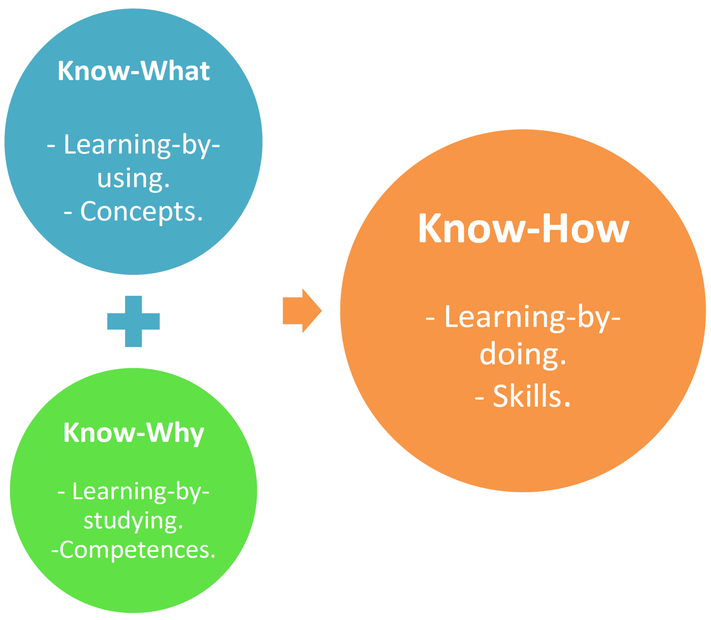
Accumulation (concepts / skills):
pre-Bologna process

Application with a strategy (competences):
European Higher Education Area (after Bologna process)

TRANSITION:
new teaching-learning paradigm

Types

Know-What: concepts, facts and descriptions.
Know-How: skills, procedures and methods.
Know-Why: competences, theories and experimentation.



CHEMISTRY LEARNING

Approach

Surface learning (Know-What):
- Mere reformulation of concepts.
- Lack of chemical principles understanding.

Deep learning (Know-Why):
- Elaborated reasoning.
- Causal relationship between phenomena.

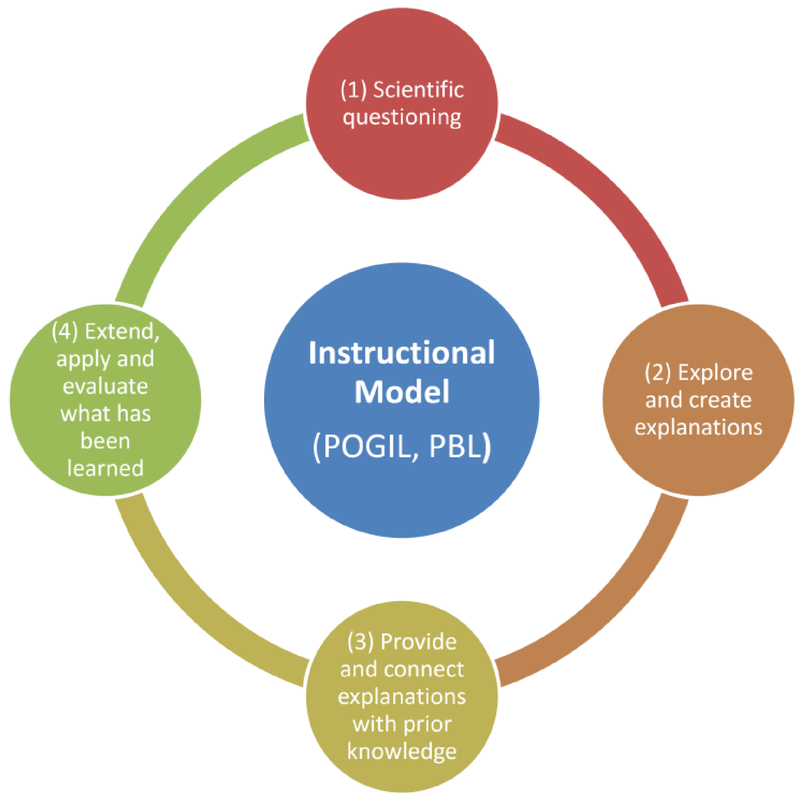
Instructional Model

POGIL

Process Oriented Guided Inquiry Learning

PBL

Problem-Based Learning



PROBLEM-BASED LEARNING MODEL

Problem Levels

LEVEL I — Know-What
- **Elements:** One concept.
- **Context:** known.
- **Strategies:** One, known.
- **Examples:** short-answer questions, true-false, multiple choice.

+ LEVEL II — Know-Why
- **Elements:** One method and concept.
- **Context:** unknown.
- **Strategies:** Many, known.
- **Examples:** exercises, conceptual derivations.

= LEVEL III — Know-How
- **Elements:** Many methods and concepts.
- **Context:** unknown.
- **Strategies:** Many, unknown.
- **Examples:** open-ended problems, projects.

Teaching Protocol

A. Control groups:

Group 1 (bottom-up):

Know-What (concepts) → Know-Why → Know-How (project)

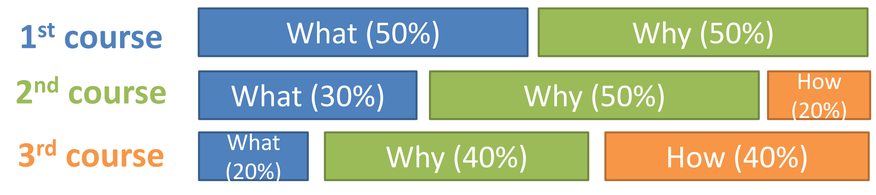
Group 2 (top-down):

Know-How (project) → Know-Why → Know-What (concepts)

Assessment tool:

STUDENT´S PORTFOLIO

B. Multi-course assessment:



CONCLUSIONS

- A **protocol for assessing** which type of knowledge is more appropriate for competence acquisition (**"know-what"** -concepts-, **"know-how"** -procedures- or **"know-why"** -competences-) is proposed.
- In a **class, two control subsets** are defined: **bottom-up learning** (Group 1, from "know-what" to "know-how") and **top-bottom** learning (Group 2, from "know-how" to "know-what").
- A **3 course assessment** is proposed to study the **student´s maturity effect** on competence learning, where the **weight of "know-how"** is progressively increased.